REMARKS / ARGUMENTS

In the Specification, the U.S. Patent Application Serial Number 09/979,588 has been corrected to: 08/979,588. The objection to the Specification is deemed to be overcome.

In the Original Claims, the previously submitted new claims 121-150 have been renumbered as new claims 122-151, and the originally filed claims 1-121 have been canceled. Accordingly, all objections to the claims have been addressed and corrected. Consequently, the objections to the claims are deemed to be overcome.

Claim 122 is rejected under 35 USC 112, first paragraph, as failing to comply with the written description requirement. In particular, the Examiner has asserted that the specification says nothing about "a single-frequency" edge detector in lines 7-8 of claim 122. In response, Applicant has amended claim 122 so as to remove the limitation "single-frequency". Accordingly, the rejection is deemed to be overcome. Claims 123-147 are also therefore now allowable.

Claim 150 was rejected under 35 USC 112, second paragraph. Claim 150 has been amended so that "provide a column, a row", has been made more clear

so as to state the requirement of: using each estimate of gradient magnitude and gradient direction to identify points where the gradient magnitude is a local maximum, and to provide a column number, a row number, a gradient magnitude and a gradient direction for each such point. Accordingly, the rejection is deemed to be overcome. Claim 151 is also therefore now allowable.

Claims 148 and 149 were rejected under 35 USC 103(a) as being unpatentable over Wilkinson (5,280,351) in view of Borer (6,345,106).

Claim 148 relates to a "tunable boundary detector", that includes a "tunable low-pass filter". By contrast, Wilkinson teaches only a low-pass filter 11 (see Fig. 2a) that is NOT tunable, instead being fixed. Wilkinson is silent on any means for adjusting or tuning the low pass filter (col. 3, lines 60-65). Thus, Wilkinson does not teach the first element.

Wilkinson does not teach the second element, i.e., does not teach a gradient estimator configured to provide an **estimate** of horizontal and vertical **components** of image gradient at each pixel position. Instead, Wilkinson teaches a high-pass filter 12 of the Hilbert type that has the effect of differentiating the video signal (col. 3, lines 66-68, and col. 4, lines 1-4). Wilkinson is silent on an "estimate", and is silent on the "horizontal and vertical components" of image gradient at each pixel position. Thus, Wilkinson is silent on the second element.

Moreover, Wilkinson is silent on the third element, i.e., the "Cartesian-to-polar converter configured to convert each estimate of horizontal and vertical components of image gradient into an estimate of gradient magnitude and gradient direction". This further supports the fact that Wilkinson is silent on the second element, since Wilkinson teaches gradient vectors, which are known in the art to consist of a gradient magnitude and a gradient direction, while NOT teaching resolving those gradient vectors into their horizontal and vertical components. Thus, the third element is not taught by Wilkinson

The fourth element of amended claim 148 requires:

a peak detector configured to use each estimate of gradient magnitude and gradient direction to identify points where the gradient magnitude is a local maximum, and to provide for each such point a column number, a row number, a gradient magnitude and a gradient direction.

According to Wilkinson, the result of differentiating the video signal is to provide a clear distinction between positive and negative object edges (col. 4, lines 4-5). The very next step taught by Wilkinson is to then subject the video signal to a sub-pixel interpolation process in a half-pixel offset plus phase shift device 13 (col. 4, lines 7-9).

By contrast, the next step taught and claimed by Applicant in amended claim 148 is "to identify points where the gradient magnitude is a local maximum". Although the Examiner has cited col. 8, lines 41-44, "samples are

multiplied with the aim of detecting a peak or maximum value. This is essentially the process of cross correlation". This is found in the discussion of "vector detection" (col. 8, lines 34-35), and represents the "product case" (col. 8, line 41). This is essentially the "means for determining for each pixel of said interlaced video signal a gradient vector corresponding to the maximum correlation magnitude" of claim 9 of Wilkinson, col. 18, lines 27-29. However, Applicant does NOT teach or claim computing "the **maximum correlation magnitude**", instead teaching and claiming computing "points where the **gradient magnitude is a local maximum**".

The Examiner cites col. 12, lines 40-63, but these lines also do not teach computing "points where the **gradient magnitude** is a local maximum", instead teaching "**correlation** peaks" (col. 12, line 59). Thus, Wilkinson does not teach the fourth element of amended claim 148.

Regarding the fifth element of amended claim 148, which requires:

"a sub-pixel interpolator configured to use each column number, row number, gradient magnitude and gradient direction to provide for each such point a vertical component of real valued edge position, a horizontal component of real valued edge position, a gradient magnitude, and a gradient direction".

By contrast, Wilkinson teaches a very different sub-pixel interpolator that for **each** pixel does NOT provide a vertical component of real valued edge position, does NOT provide a horizontal component of real valued edge position, does NOT provide a gradient magnitude, and does NOT provide a gradient

direction. Instead, Wilkinson teaches "a sub-pixel interpolation process in a half-pixel offset plus phase shift device 13" (col. 4, lines 7-9). Wilkinson goes on to say that "The object of this sub-pixel interpolation is to ensure that each gradient vector is aligned with the intended interpolation point" (col. 4, lines 9-11). This is clearly different from the object of Applicant's sub-pixel interpolation, which is to provide a gradient magnitude and gradient direction at a real valued edge position, as claimed in amended claim 148.

The Examiner also cites col. 5, line 66 –col. 6, line 4, which relates to "motion vectors" (col. 5, line 57), which are not taught or claimed by Applicant.

The Examiner additionally cites col. 6, lines 44-54, which relates to ensuring that "each motion vector is aligned with the intended interpolation point" (col. 6, lines 52-54), and as such, is clearly different from Applicant's invention as taught and claimed, wherein sub-pixel interpolation provides a gradient magnitude and gradient direction at a real valued edge position, as claimed in amended claim 148.

Thus, Wilkinson does not teach the fifth element of amended claim 148.

The Examiner admits that Wilkinson does not expressly call for a Cartesian/rectangular to Polar converter. This is because Wilkinson is silent on expressing image gradient vectors in the Cartesian/rectangular form, instead only expressing them only in Polar form. Thus, there is no need for such a converter, and consequently there is no motivation to combine with Wilkinson any reference

that teaches a Cartesian/rectangular to Polar converter, such as Borer. Accordingly, the rejection of claim 148 is deemed to be overcome.

Regarding claim 149, the Examiner cites col. 5, lines 4-17, and Fig. 4 of Wilkinson. However, this teaching is silent on "an adjustable image sub-sampler", as required by claim 149. Moreover, claim 149 depends from claim 148, deemed to be allowable. Therefore, claim 149 is also deemed to be allowable.

Claims 150 and 151 were rejected under 35 USC 103(a) as being unpatentable over Lee (5,694,487) in view of Wilkinson (5,280,351).

Claim 150, as herein amended, requires two elements not present in Lee or Wilkinson:

> using each estimate of gradient magnitude and gradient direction to identify points where the gradient magnitude is a local maximum, and to provide for each such point a column number, a row number, a gradient magnitude and a gradient direction; and
>
> using each column number, row number, gradient magnitude, and gradient direction to provide for each such point a vertical component of real valued sub-pixel edge position, a horizontal component of real valued sub-pixel edge position, a gradient magnitude, and a gradient direction.

Although Lee calculates gradient components in the X and Y directions, and then computes gradient magnitude at each point, Lee is silent on identifying "points where the gradient magnitude is a local maximum". Instead, Lee

identifies feature points of interest by calculating variance (see Abstract, lines 12-17.

Further, Lee identifies feature points only to the precision of pixel location, but not to the precision of "real valued sub-pixel edge position", as required by amended claim 150.

The Examiner admits that Lee does not teach filtering, citing Wilkinson. However, Wilkinson does not repair the other deficiencies of Lee, and so combining Lee and Wilkinson does not provide the invention of claim 150. The rejection of claim 150 is deemed to be overcome.

Claim 151 was rejected, the Examiner citing Wilkinson, Fig. 4, and col. 5, lines 4-17, teaching sub-sampling after filtering. However, since claim 151 depends on claim 150 deemed herein to be allowable, and since Wilkinson does not repair the deficiencies of Lee, combining Lee and Wilkinson will not provide the invention claimed in claim 151. Accordingly, the rejection of claim 151 is deemed to be overcome.

The prior art made of record and not relied upon does not appear to present an impediment to the allowance of the present application.

Accordingly, Applicants assert that the present application is in condition for allowance, and such action is respectfully requested. The Examiner is invited

to phone the undersigned attorney to further the prosecution of the present application.

Respectfully Submitted,

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